Restricted Circulation

This paper is not an official document; it is for information only and reference cannot be made to it in any printed publication without the permission of the author.

AGRICULTURAL MEMORANDUM No 412

(Dr M Hough)

Weather Factors Affecting the Development of Barley

An attempt is made to relate the dates of ear emergence and dead ripeness to weather conditions. The barley variety Kenia is considered for the 10 years 1954 - 1963. It was grown at Sparsholt Hampshire where weather data (10-day means) was available for 1956 - 1963. Weather data for 1954 and 1955 was obtained from Leckford at a similar altitude about 4 miles from the trial site.

Date of Ear Emergence

Kenia appears to be a "long day" photoperiod variety with the critical daylength occurring sometime in April. The ear emergence date depends upon weather conditions after the critical photoperiod has been reached. This was discussed by Cooper (1952) for ryegrass.

The relation between the ear emergence date and the mean air temperature during May had a correlation of -0.63, and clearly some other factor was also important. The search for such a weather factor was not particularly successful, but nevertheless when the severity of mildew attack before ear emergence was taken into consideration an improvement in relationship was found. This is sensible since a heavy infestation of mildew is a drain on the carbohydrate production of the plants, and this would be particularly serious at the time of maximum stem elongation. A mildew severity scale was devised from the field notes (1 - no mildew, 2 - slight attack, 3 - severe attack).

By using the mean May temperature and mildew incidence it is possible to estimate the date of ear emergence to within a mean error of 1.3 days.

The regression equation is

$$E = -4.9\ T + 7.4\ M + 56$$

E is the date in June of ear emergence.
T is the mean air temperature in May °C.
M is the severity of mildew attack (i.e. 1, 2 or 3).

Date of Dead Ripeness

After ear emergence the grains are filled by photosynthates from the awns and (possibly) the flag leaf. The leaves begin to die in early July and grain filling ceases towards the end of that month. Water is then lost from the grain at a rate which depends upon the actual grain moisture content and the supply of energy for evaporation (potential transpiration) (Ag. Mem.393).

FH1

Rain may be intercepted by the ears (up to about 0.5 mm), but water is not absorbed by the grain provided the moisture content is above about 33% (dry weight basis). When the grain moisture content falls below this value then uptake of moisture from rain is possible (Ag. Mem. 393).

The critical period for both the death of the leaves and for the initial stages of grain drying is about the end of July. A dry spell at this time would be expected to hasten the death of leaves and encourage rapid drying during the first stage of grain drying. Potential transpiration, air temperature, rainfall, number of rain days and rainfall duration are possible choices of weather variables in this context. The latter part of the drying out process is more difficult because an hour's steady rain after a dry spell increases the grain moisture content by almost as much as a far longer spell of rain (Bruck and Van Elderen, 1969).

All weather variables except rainfall duration were available. The duration was therefore estimated using Daily Weather Reports. The observations at Boscombe Down and Hurn were used together with the synoptic maps. Well marked depressions with clear frontal passages were the easiest systems to deal with, and the estimated duration of rain is probably accurate to about an hour. Showery situations were more difficult and showers were credited to Sparsholt only if both Hurn and Boscombe Down had showers. If Sparsholt was credited with a shower during a 6 hour period, then the duration was set equal to $\frac{1}{2}$ an hour. If frequent showers or a heavy thunderstorm occurred then 1 hour was used as the duration. This is obviously not very satisfactory, but at least the major periods of rain should be fairly accurately timed.

Barley (and probably other cereals) seems to have an "internal clock" which governs the phenology to some extent. If the duration from sowing to ear emergence is shorter than normal then the duration between ear emergence and dead ripeness is longer than normal and vice versa.

Multiple linear regression equations were found with the number of days between ear emergence and dead ripeness as the dependent variable and various combinations of weather factors plus the sowing to ear emergence duration as independent variables. Mean errors for the different combinations were found and details are set out in the table.

The smallest mean error in the prediction of harvest date was 2.4 days. For the year 1956 the dead ripe date was predicted 7 to 8 days too early by all the methods, whereas the error is normally below 4 days for the other years. This may show some error in the estimation of dead ripeness for that year. If 1956 were omitted, then much better fits could be obtained.

It is proposed to test the methods used for Sparsholt on similar data from other European countries.

Any comments or criticisms should be sent direct to the author.

Meteorological Office
Met O 8a
London Road
Bracknell
Berks

September 1971

References

Bruck, E G M	1969	Field drying of hay and wheat.
Van Elderen, E		J Agric. Engng. Res. 14(2), 105-116
Cooper, J P	1952	Studies on growth and development in holium 3. Influence of season and latitude on ear emergence. J. Ecol. Vol. 40 pp 352-379.

Table

X Number of days between sowing and ear emergence (days).

RT Rainfall total from 21 to 31 July (mm).

(P-RT) Potential transpiration minus rainfall from 21 to 31 July (mm).

RD Rainfall duration from 21 to 31 July (hours).

T Mean July air temperature (°C).

P Potential transpiration 21 to 31 July (mm).

R Number of rain days (amounts $\geq$ 0.2 mm) 21 to 31 July (days).

D Number of days between ear emergence and dead ripeness (days).

Combination of independent variables	Mean error (days) in date of dead ripeness	Regression equation
X, R	2.4	D = -0.44X +3.16R +87
X, T, RT	3.0	D = -0.68X +1.2T +0.47RT +93
X, RT	3.2	D = -0.62X +0.40RT +107
X, (P-RT)	3.2	D = -0.69X -0.26(P-RT) +125
X, P, RT	3.2	D = -0.63X +0.82P +0.42RT +106
X, RD	4.3	D = -0.49X +0.33RD + 99
X, T	4.4	D = -0.40X -2.1T +129
X, RD, RT	4.7	D = -0.13X +0.13RT -0.03RD +68